DEMODULATED
RECEPTION DATA

CLOCK
EXTRACTION
CIRCUIT

111

PHASE
DIFFERENCE
MEASUREMENT
CIRCUIT

112

REFERENCE VALUE
FOR DEVIATION

DEVIATION
CALCULATION
CIRCUIT

113

SQUARING
CALCULATION
CIRCUIT

114

AVERAGE
VALUE
CALCULATION
CIRCUIT

115

REFERENCE VALUE
FOR DETERMINATION
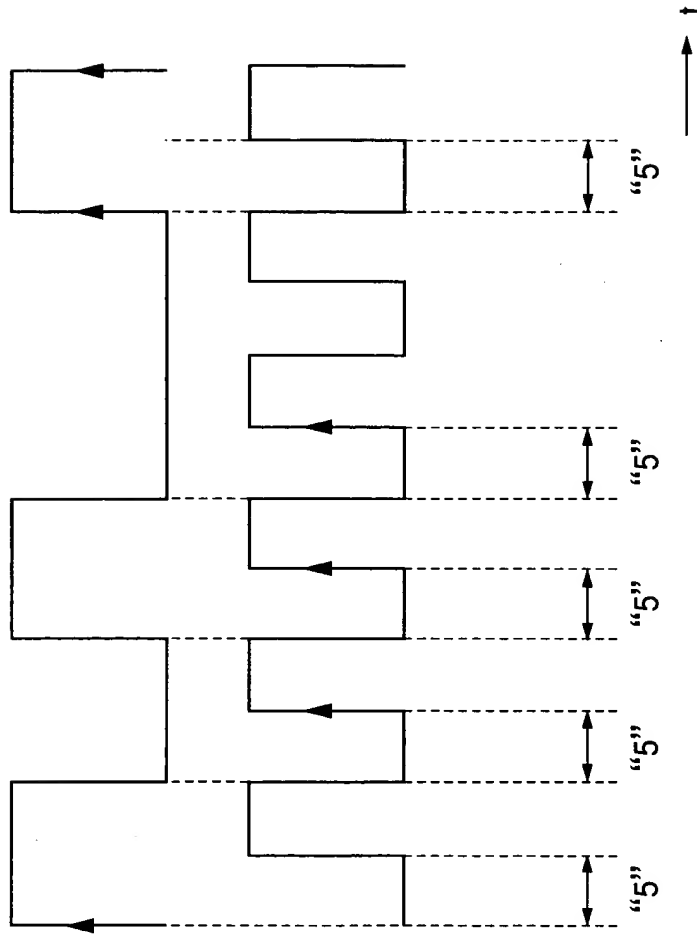
COMPARISON
CIRCUIT

116

DISCRIMINATION
SIGNAL

FIG. 1 PRIOR ART
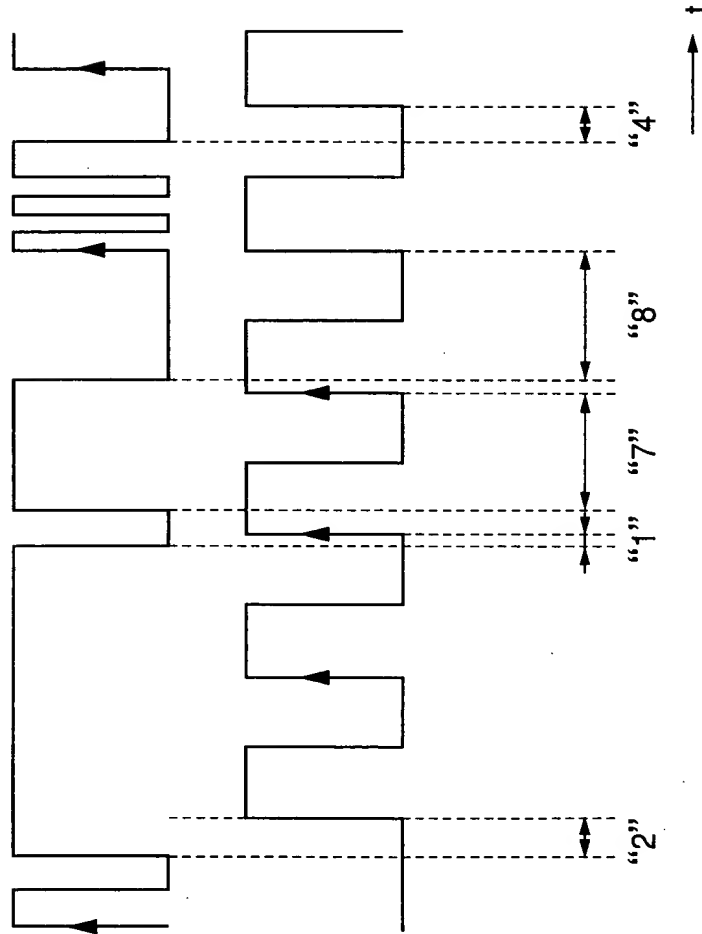
FIG. 2A
PRIOR ART

FIG. 2B
PRIOR ART

FIG. 2C
PRIOR ART

"5" "5" "5" "5" "5"

t

FIG. 3A
PRIOR ART

FIG. 3B
PRIOR ART

FIG. 3C
PRIOR ART

"2"   "1"   "7"   "8"   "4"

t

DEMODULATED
RECEPTION DATA

117
DEMODULATING
CIRCUIT

118
SYNCHRONIZATION
CODE DETECTION
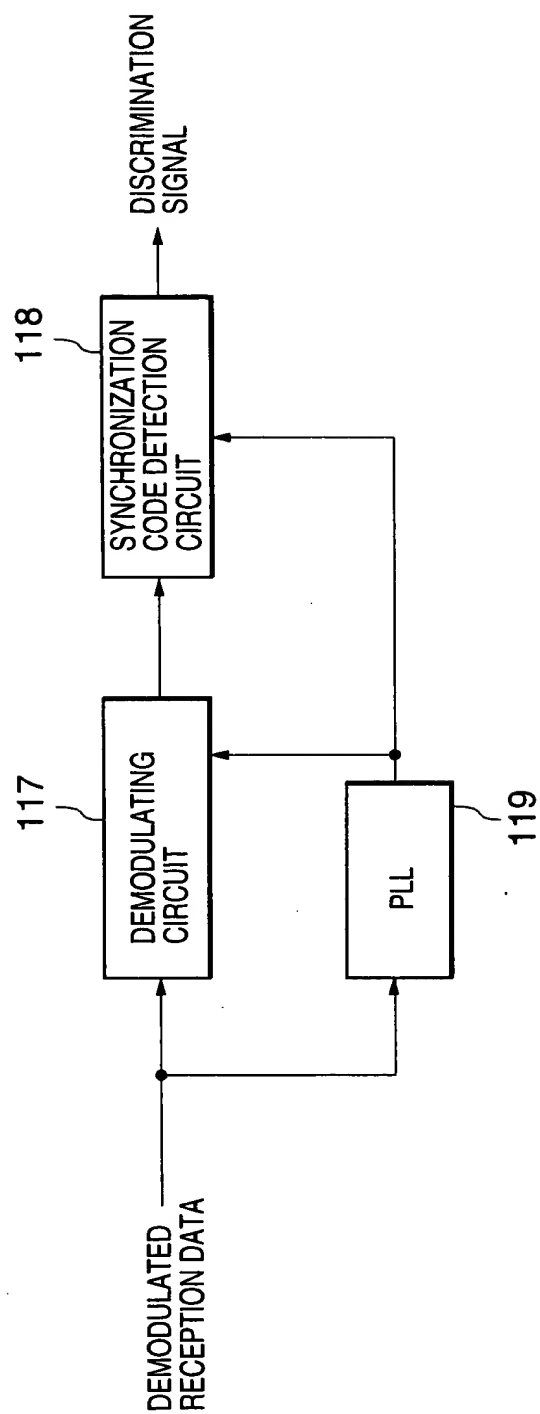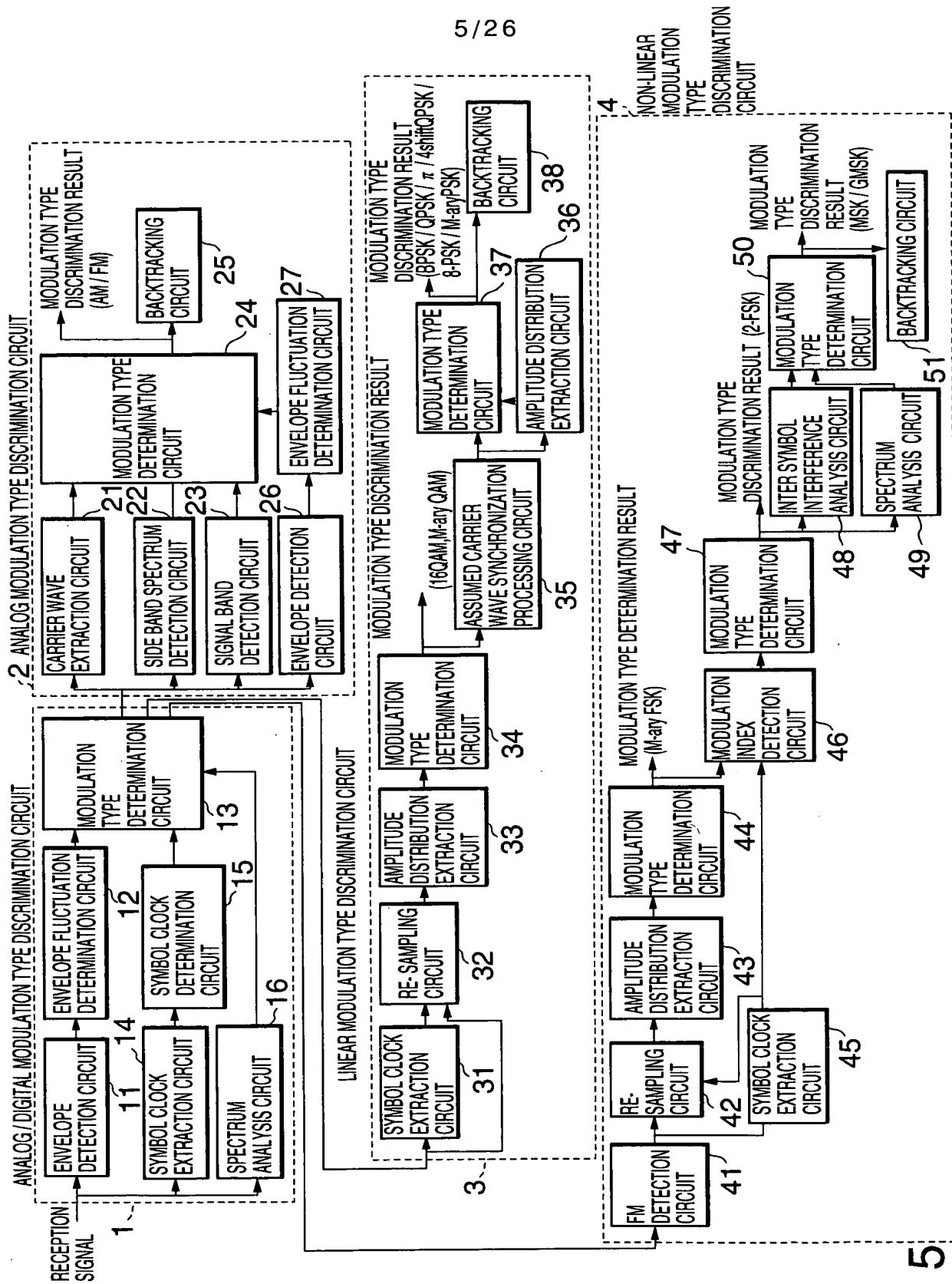CIRCUIT

DISCRIMINATION
SIGNAL

119
PLL

FIG. 4 PRIOR ART

FIG. 5
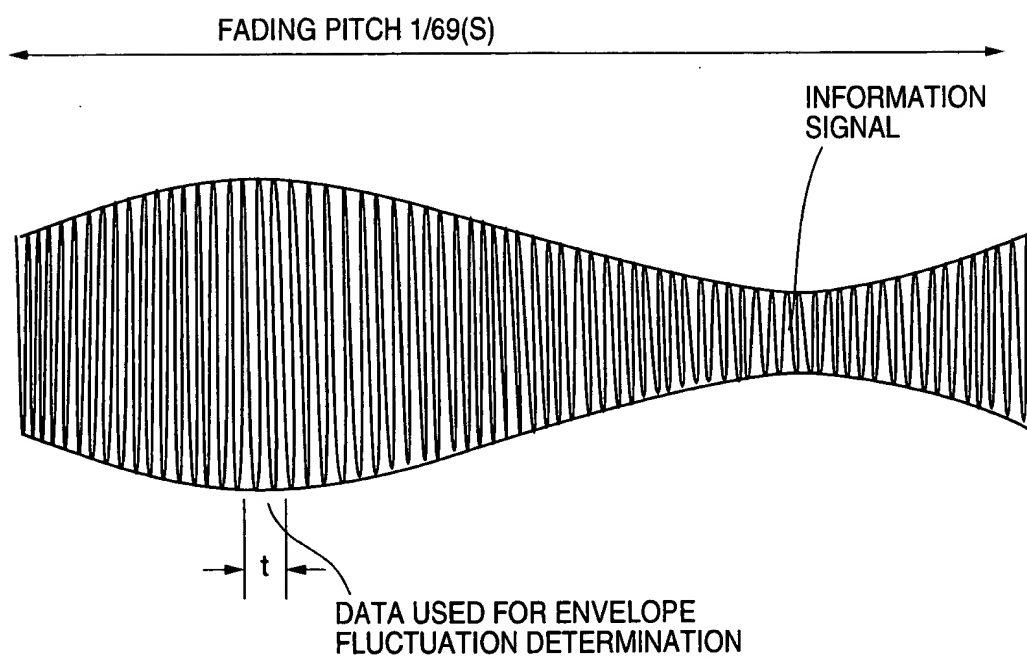
FIG. 6

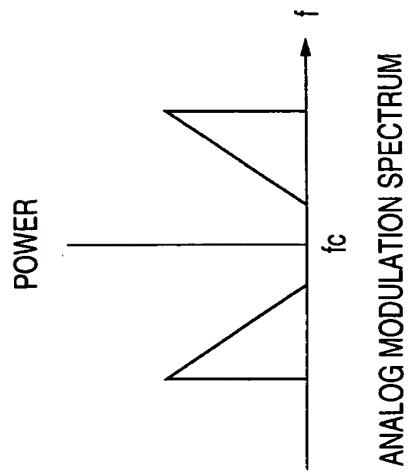| OBJECT / CHARACTERISTIC	ANALOG MODULATION TYPE	DIGITAL LINEAR MODULATION TYPE	DIGITAL NON-LINEAR MODULATION TYPE	REMARK
EXISTENCE/ NONEXISTENCE OF SYMBOL CLOCK	0	1	1	EXISTENCE:1 NON-EXISTENCE: 0
ENVELOPE FLUCTUATION	AM-1 FM-0	1	0	EXISTENCE:1 NON-EXISTENCE:0
SPECTRUM SHAPE	(AM) TWO SIDE BAND SPECTRUMS SYMMETRICAL ABOUT CARRIER WAVE SPECTRUM	BAND RESTRICTION TYPE SPECTRUM SHARPLY ATTENUATES	SPECTRUM EXISTS OVER WIDE BAND SPECTRUM ATTENUATES ACCOMPANYING WITH DETUNING OF FREQUENCY	

FIG. 7
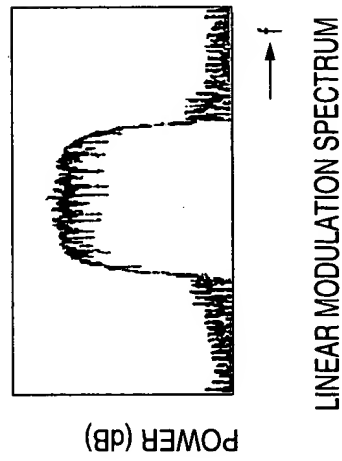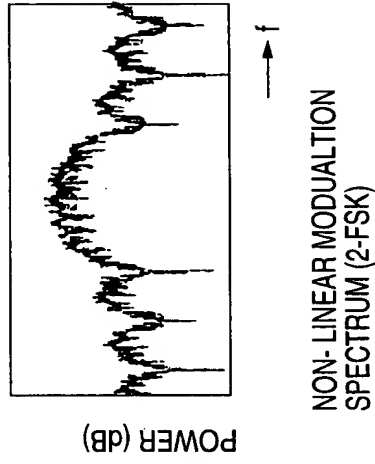
ANALOG MODULATION SPECTRUM

FIG. 8A

LINEAR MODULATION SPECTRUM

FIG. 8B

NON- LINEAR MODUALTION
SPECTRUM (2-FSK)

FIG. 8C

OBJECT CHARACTERISTIC	AM	FM	REMARK
EXISTENCE / NON-EXISTENCE OF CARRIER WAVE SPECTRUM	1	—	EXISTENCE:1 NON-EXISTENCE:0
EXISTENCE / NON-EXISTENCE OF SYMMETRY OF SPECTRUM	1	0	EXISTENCE:1 NON-EXISTENCE:0
SIGNAL BAND WIDTH	0	1	EXCLUDING NARROW BAND FM, DIFFUSION SPECTRUM :1 NON- DIFFUSION SPECTRUM :0
ENVELOPE FLUCTUATION	1	0	EXISTENCE :1 NON- EXISTENCE :0

FIG. 9

BPSK

FIG. 10A

QPSK
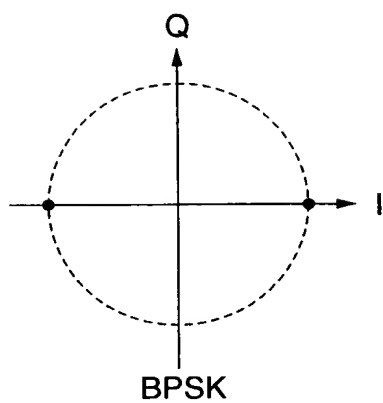
FIG. 10B

$\pi/4$-shift QPSK
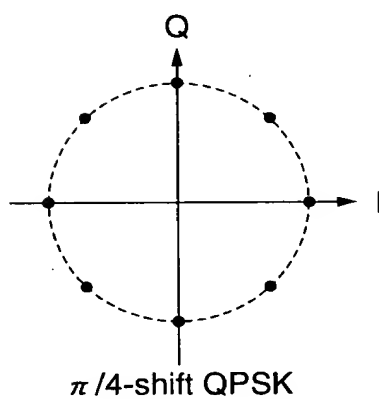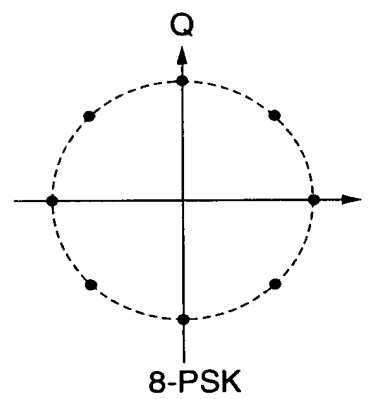
FIG. 10C
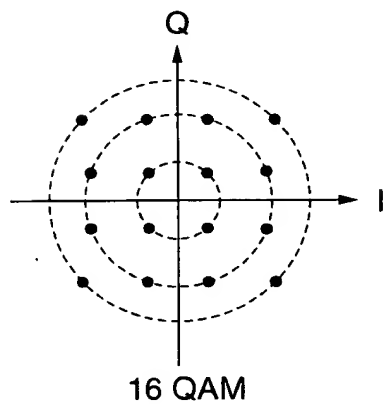
8-PSK

FIG. 10D

16 QAM

FIG. 10E
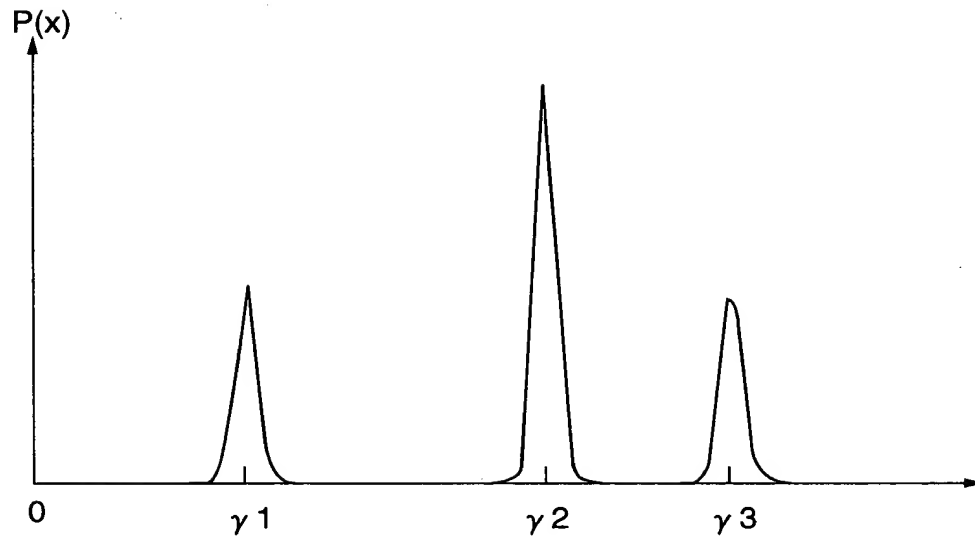
16QAM

FIG. 11A

64QAM

FIG. 11B

8-PSK

FIG. 12B

X : SYMBOL CONVERGENCE POSITION OF (ODD NUMBER)-TH
/(EVEN NUMBER)-TH

π /4-shift QPSK

FIG. 12A

○ : SYMBOL CONVERGENCE POSITION OF (ODD NUMBER)-TH
△ : SYMBOL CONVERGENCE POSITION OF (EVEN NUMBER)-TH

π/4-shift QPSK

ODD NUMBER-TH

EVEN NUMBER-TH
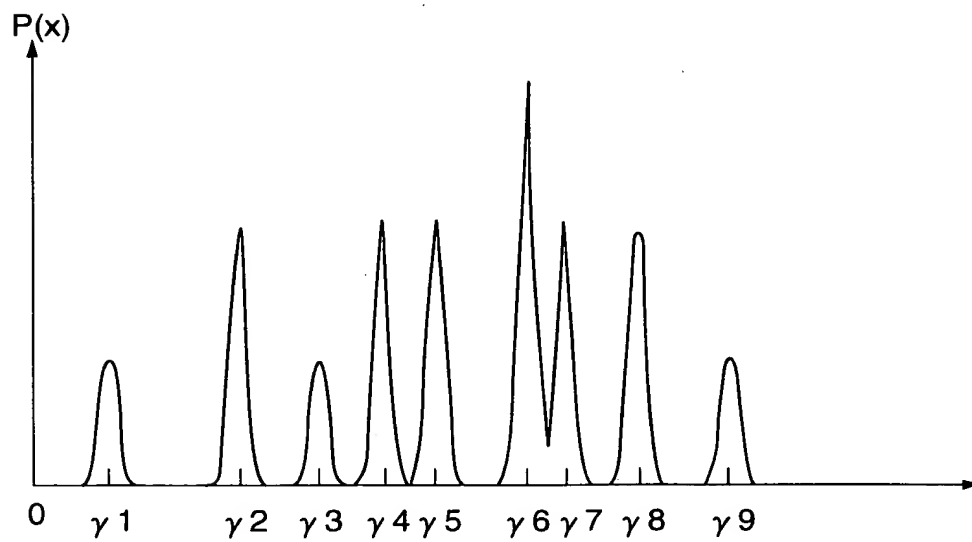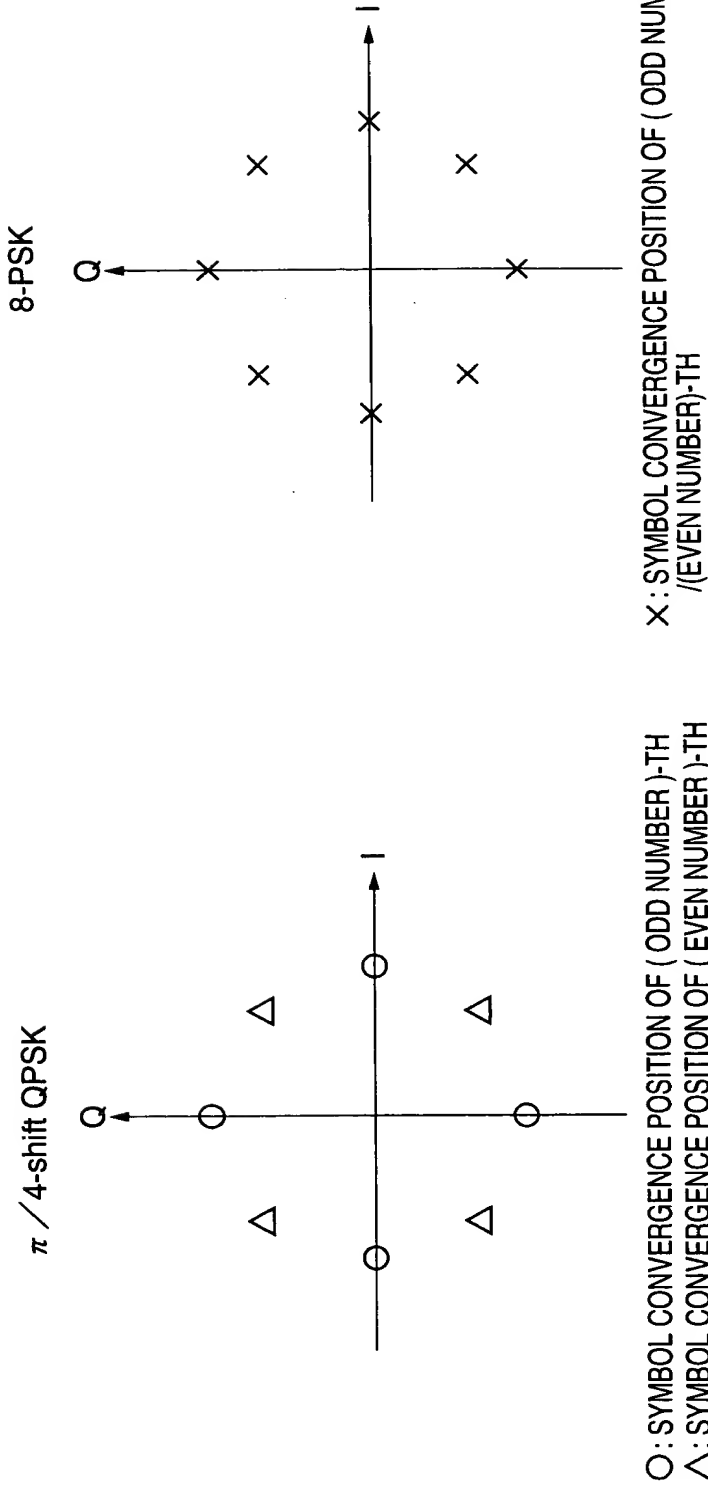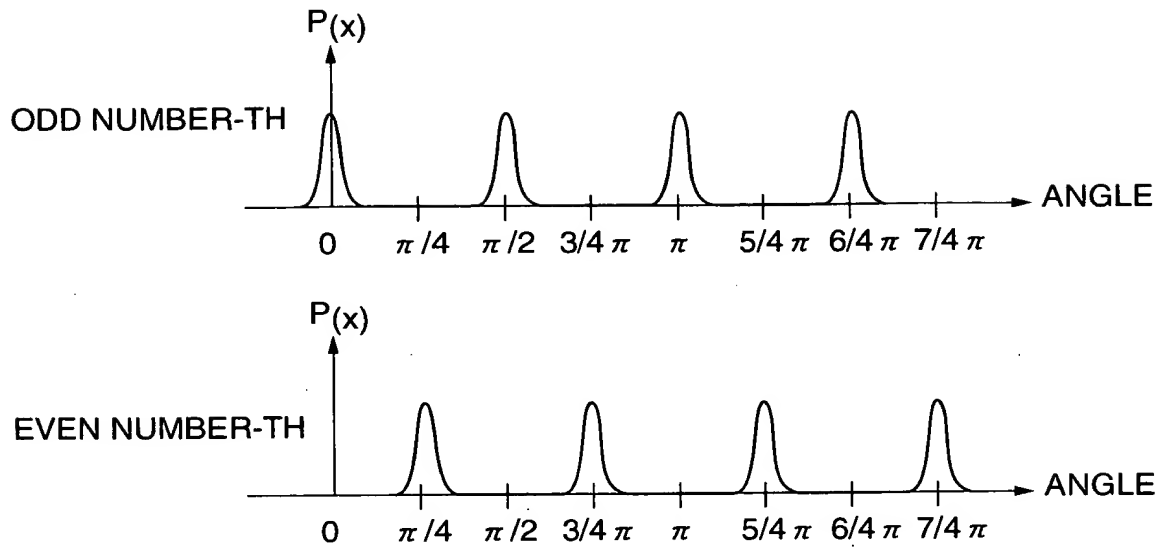
FIG. 13A

8-PSK

FIG. 13B
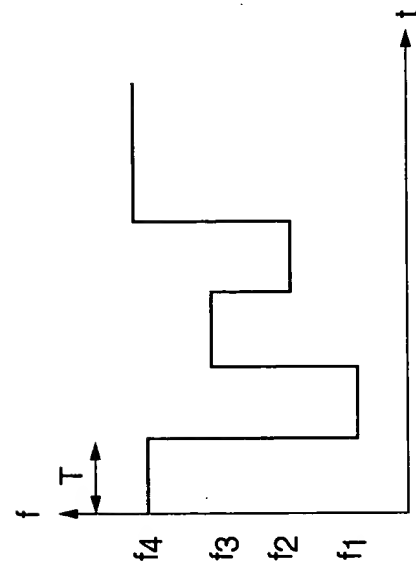
M-ary FSK
(CASE OF M=4)

FIG. 14A
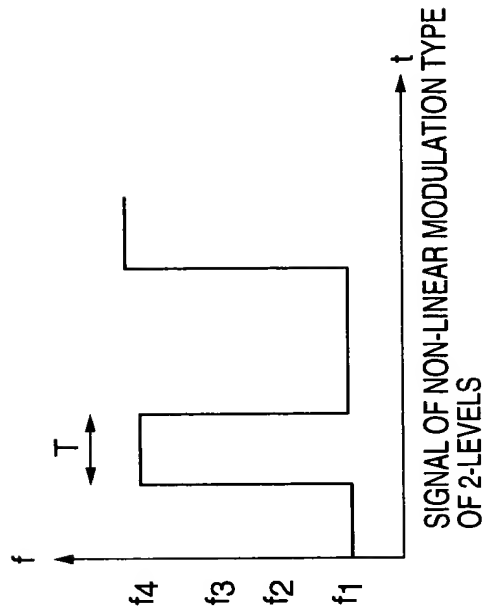
SIGNAL OF NON-LINEAR MODULATION TYPE
OF 2-LEVELS

(2-FSK,MSK)

WHERE, T IS SYMBOL CLOCK TIME

FIG. 14B
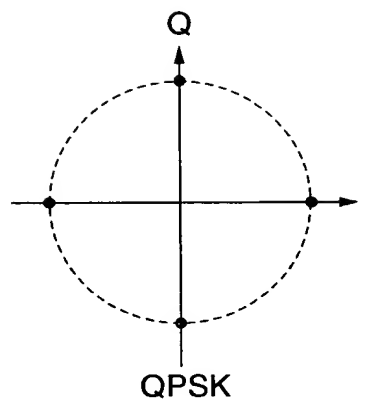
FIG. 15

FIG. 16

FIG. 17

FIG. 18

FIG. 19

RECEPTION SIGNAL OF UNKNOWN COMMUNICATION ELEMENTS

CHARACTERISTIC EXTRACTION PROCESSING FOR ANALOG MODULATION / LINEAR DIGITAL MODULATION / NON-LINEAR DIGITAL MODULATION TYPE — S1

DETERMINATION OF ANALOG MODULATION / LINEAR DIGITAL MODULATION / NON-LINEAR DIGITAL MODULATION TYPE — S2

(NON-LINEAR DIGITAL MODULATION TYPE)

RE-SAMPLING PROCESSING — S13

FM DETECTION / RE-SAMPLING PROCESSING

AMPLITUDE DISTRIBUTION EXTRACTION PROCESSING (CONSTELLATION CONVERGENCE CHARACTERISTIC) — S14

M-ary FSK DETERMINATION — S15

YES → M-ary FSK

NO

MODULATION INDEX EXTRACTION PROCESSING — S16

2-FSK DETERMINATION — S17

YES → 2-FSK

NO — S18

INTER SYMBOL INTERFERENCE EXTRACTION PROCESSING (TIME AXIS FREQUENCY AXIS CHARACTERISTIC)

MSK / GMSK DETERMINATION — S19

YES → MSK / GMSK

NO

BACKTRACKING PROCESSING — S20

(LINEAR DIGITAL MODULATION TYPE)

RE-SAMPLING PROCESSING — S6

AMPLITUDE DISTRIBUTION CHARACTERISTIC EXTRACTION PROCESSING (VECTOR RADIUS CHARACTERISTIC) — S7

16QAM DETERMINATION — S8

YES → M-ary 16-QAM QAM

NO — S9

MODULATION TYPE ASSUMED CARRIER SYNCHRONIZATION PROCESSING
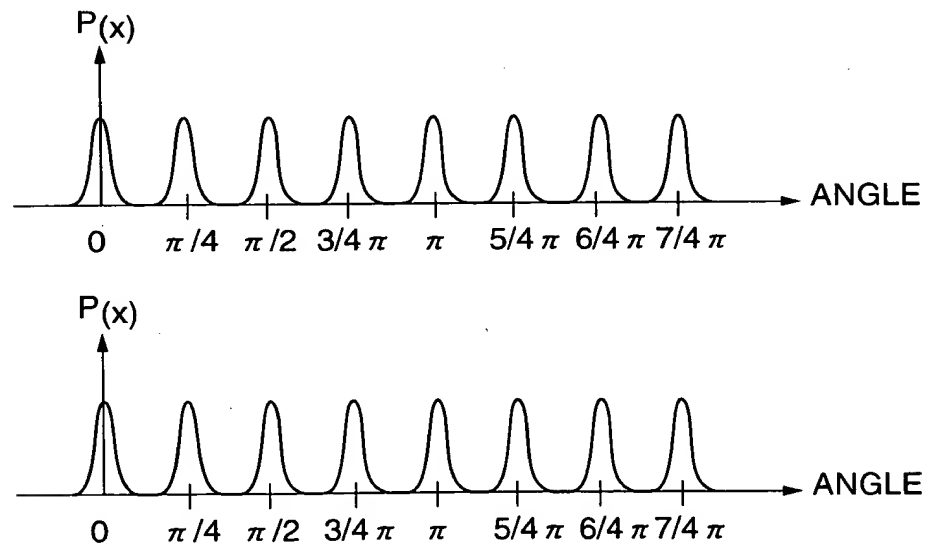
ANGLE DISTRIBUTION EXTRACTION PROCESSING (CONSTELLATION CONVERGENCE CHARACTERISTIC) — S10

DETERMINATION FOR BPSK / QPSK / π / 4-shift QPSK / 8-PSK / M-ary PSK — S11

YES → BPSK QPSK π / 4-shift 8-PSK M-ary QPSK 8-PSK PSK

NO

BACKTRACKING PROCESSING — S12

ANALOG MODULATION TYPE CHARACTERISTIC EXTRACTION PROCESSING — S3

AM/FM DETERMINATION — S4

YES → AM FM

NO

BACKTRACKING PROCESSING — S5

FIG. 20

ANALOG/DIGITAL MODULATION TYPE DISCRIMINATION CIRCUIT

MODULATION TYPE DISCRIMINATION RESULT (AM/FM)

RECEPTION SIGNAL

1

ENVELOPE DETECTION CIRCUIT — 11

SYMBOL CLOCK EXTRACTION CIRCUIT — 14

SPECTRUM ANALYSIS CIRCUIT — 16

ENVELOPE FLUCTUATION DETERMINATION CIRCUIT — 12

SYMBOL CLOCK DETERMINATION CIRCUIT — 15

MODULATION TYPE DETERMINATION CIRCUIT — 13

LINEAR MODULATION TYPE DISCRIMINATION CIRCUIT

3

SYMBOL CLOCK EXTRACTION CIRCUIT — 31

RE-SAMPLING CIRCUIT — 32

AMPLITUDE DISTRIBUTION EXTRACTION CIRCUIT — 33

MODULATION TYPE DETERMINATION CIRCUIT — 34

(16QAM, M-ary QAM)

ASSUMED CARRIER WAVE SYNCHRONIZATION PROCESSING CIRCUIT — 35

MODULATION TYPE DISCRIMINATION

MODULATION TYPE DETERMINATION CIRCUIT — 37

AMPLITUDE DISTRIBUTION EXTRACTION CIRCUIT — 36

BACKTRACKING CIRCUIT — 38

MODULATION TYPE DISCRIMINATION RESULT (BPSK / QPSK / 8-PSK / M-aryPSK / 4shiftQPSK / π /

4 NON-LINEAR MODULATION TYPE DISCRIMINATION CIRCUIT

FM DETECTION CIRCUIT — 41

RE-SAMPLING CIRCUIT — 42

SYMBOL CLOCK EXTRACTION CIRCUIT — 45

AMPLITUDE DISTRIBUTION EXTRACTION CIRCUIT — 43

MODULATION TYPE DETERMINATION CIRCUIT — 44

MODULATION TYPE DISCRIMINATION RESULT (M-ary FSK)

MODULATION INDEX DETECTION CIRCUIT — 46

MODULATION TYPE DETERMINATION CIRCUIT — 47

MODULATION TYPE DISCRIMINATION RESULT (2-FSK)

INTER SYMBOL INTERFERENCE ANALYSIS CIRCUIT — 48

SPECTRUM ANALYSIS CIRCUIT — 49

MODULATION TYPE DETERMINATION CIRCUIT — 50

BACKTRACKING CIRCUIT — 51

MODULATION TYPE DISCRIMINATION RESULT (MSK / GMSK)

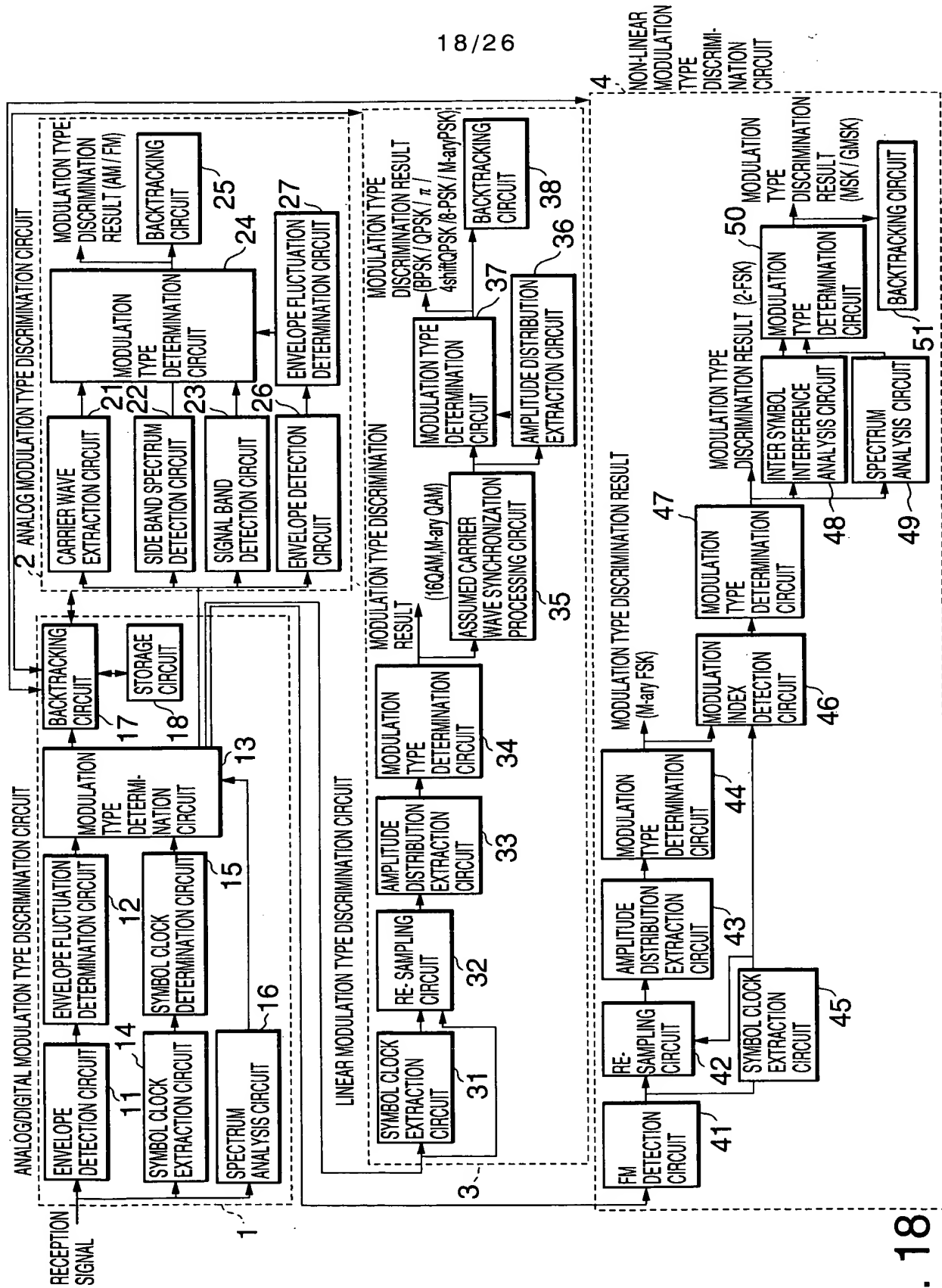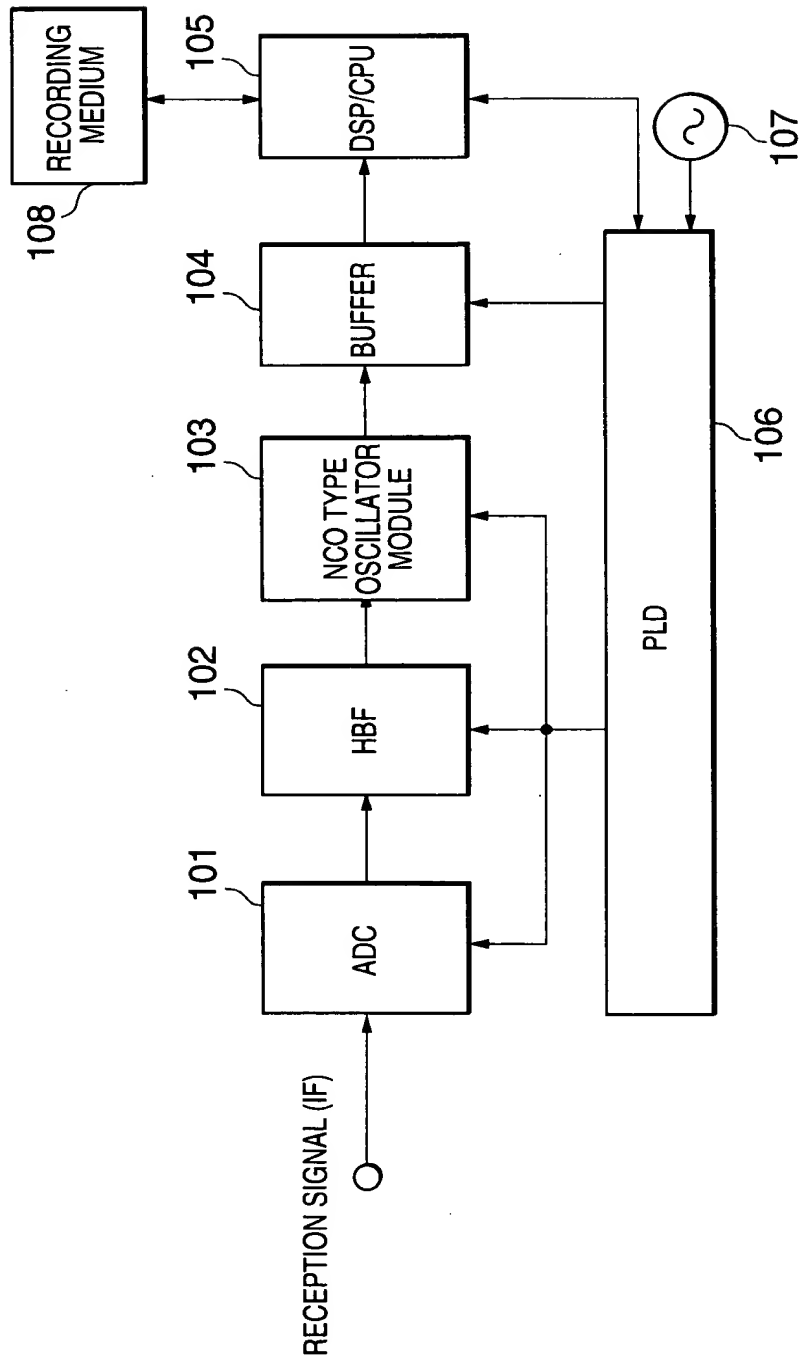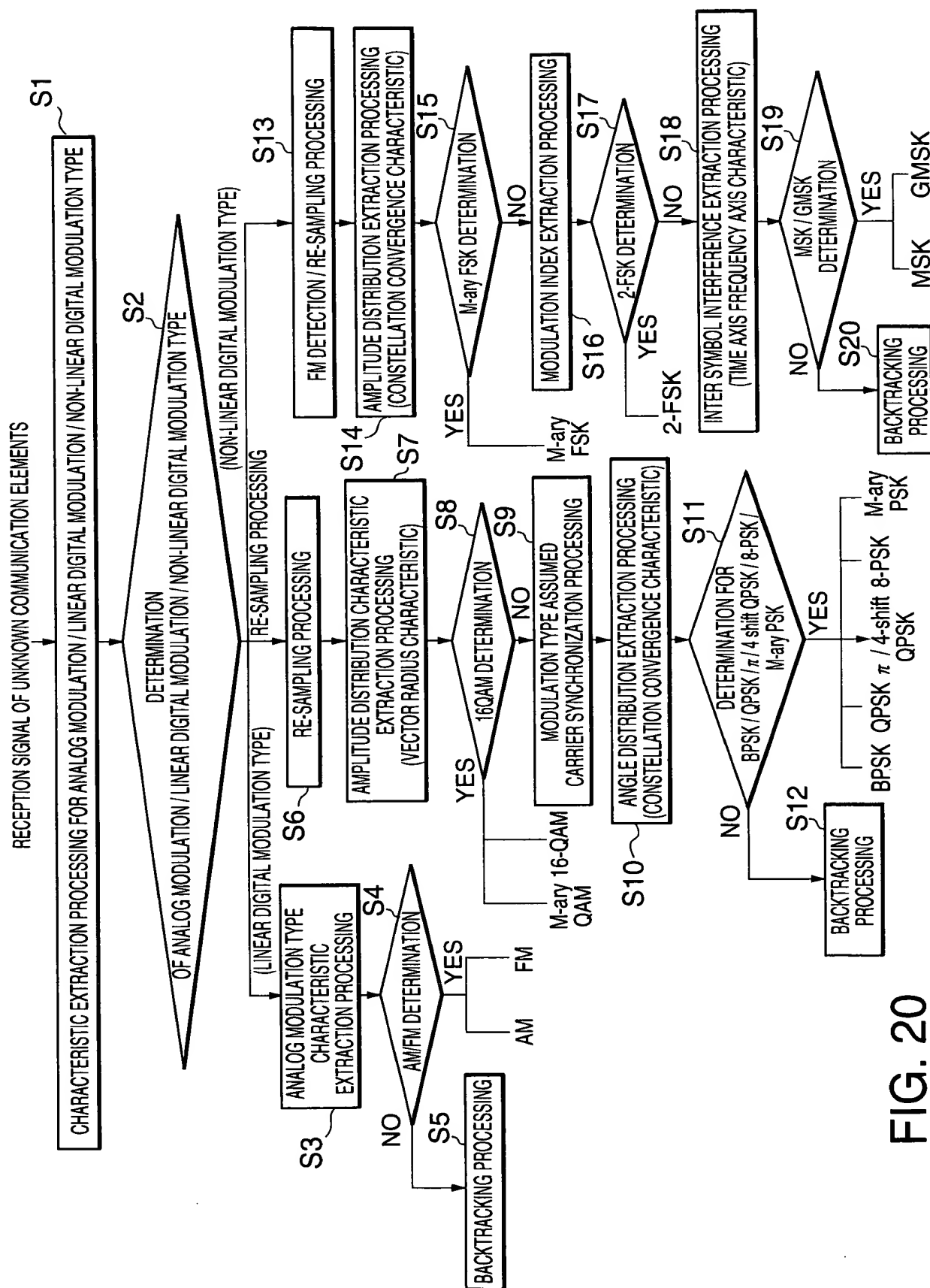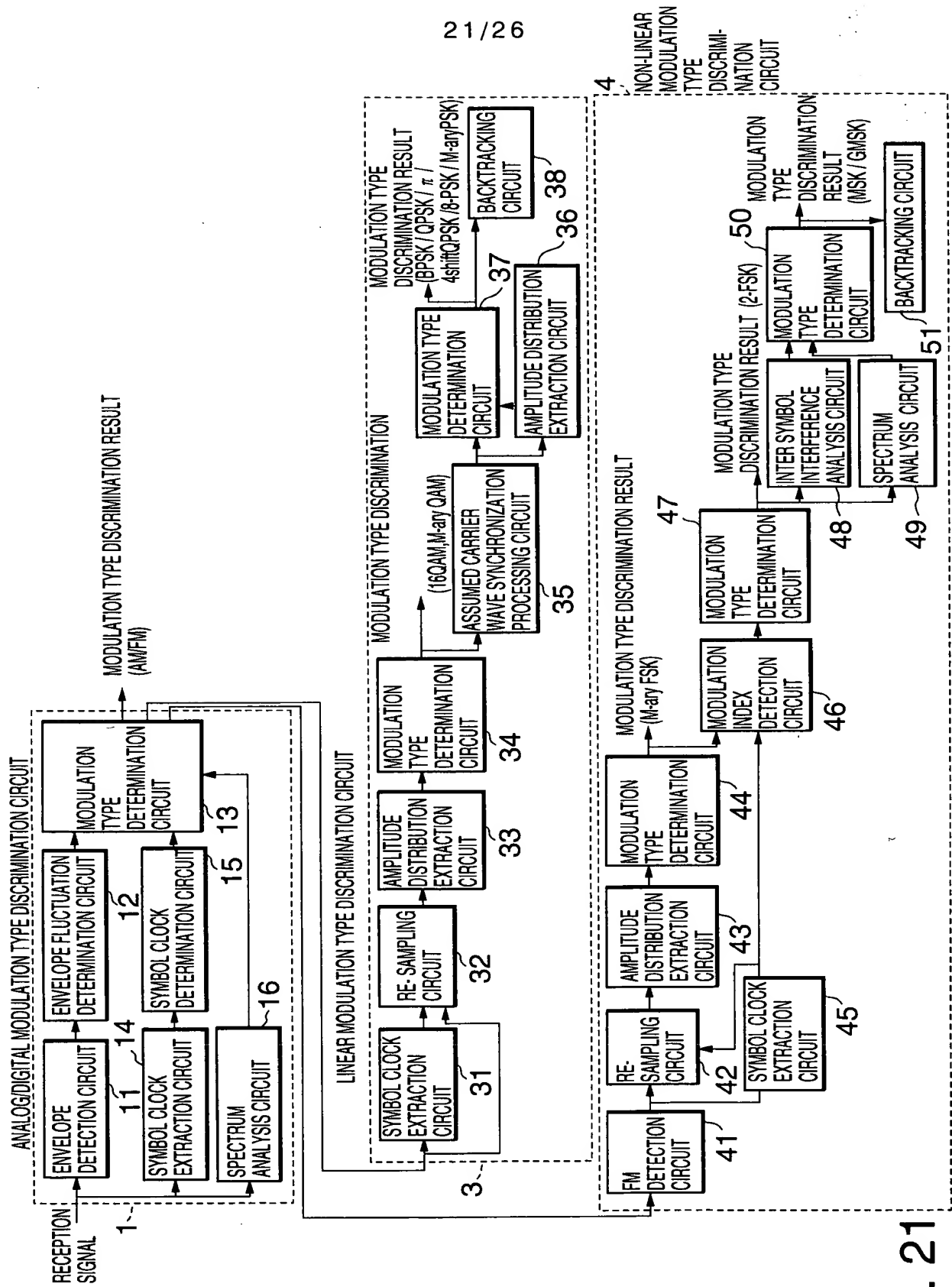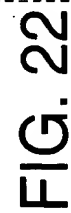# FIG. 21

FIG. 22

FIG. 23

FIG. 24

70 DISCRIMINATION CIRCUIT BY ENVELOPE FLUCTUATION CHARACTERISTIC

RECEPTION SIGNAL →

71	72	73	74	75
ENVELOPE DETECTION CIRCUIT	ENVELOPE FLUCTUATION DETERMINATION CIRCUIT	FM DETECTION CIRCUIT	SYMBOL CLOCK EXTRACTION CIRCUIT	MODULATION TYPE DETERMINATION CIRCUIT

→ MODULATION TYPE DISCRIMINATION RESULT (AM/FM)

→ TO LINEAR MODULATION TYPE DISCRIMINATION CIRCUIT 3

→ TO NON-LINEAR MODULATION TYPE DISCRIMINATION CIRCUIT 4

FIG. 25

RECEPTION SIGNAL OF UNKNOWN
COMMUNICATION ELEMENTS

S31 → ENVELOPE DETECTION PROCESSING

S32 ENVELOPE FLUCTUATION EXISTS ?

(FM OR NON-LINEAR DIGITAL MODULATION TYPE)

NO →

S33 FM DETECTION PROCESSING

S34 SYMBOL CLOCK EXTRACTION

S35 SYMBOL CLOCK EXISTS ?

YES → NON-LINEAR DIGITAL MODULATION TYPE

NO → FM

(AM OR LINEAR DIGITAL MODULATION TYPE)

YES →

S36 SYMBOL CLOCK EXTRACTION

S37 SYMBOL CLOCK EXISTS ?

YES → LINEAR DIGITAL MODULATION TYPE

NO → AM

FIG. 26